



Flora of Niti Valley: a cold arid region of Nanda Devi Biosphere Reserve, Western Himalaya, India

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Abstract: Located in the extended buffer zone of Nanda Devi Biosphere Reserve in Western Himalaya, Niti valley represents a cold arid region. The reserve has been extensively surveyed in terms of floral diversity by various workers, albeit highly confined to the core zones. The current survey recorded 495 species belonging to 267 genera and 73 families of vascular plants through systematic collection in the years 2011, 2012 and 2014. Of the recorded species, 383 were dicots, 93 monocots, 9 pteridophytes and 10 gymnosperms. Asteraceae was most diverse family (32 genera with 58 species), followed by Poaceae (22 genera with 41 species), Lamiaceae (15 genera with 19 species) Fabaceae (14 genera with 22 species), Brassicaceae (12 genera with 12 species) and Rosaceae (11 genera with 36 species). The present survey also updates the existing flora of Nanda Devi Biosphere Reserve (801 species) with addition of 167 species. This study reveals that the Niti valley forms a transition zone, as the floral elements have affinity with Trans as well as Greater Himalaya.

Key words: floristic diversity; Indian Trans-Himalaya; Nanda Devi National Park; southern Asia; Valley of Flowers National Park

INTRODUCTION

Mountainous regions of the world are fascinating as they cover an ample range of biological diversity over smaller areas (Dash and Saxena 2012). In Himalayan region, the alpine zone occupies nearly 33% of the total geographical area, of which about 25.98% area is vegetated and remaining 7.1% area falls under perpetual snow (Lal et al. 1991). The arid tracts lying extreme north and parallel to the Greater Himalayan range, constituting the sediments of Tethyan sea bed, are referred as Trans-Himalaya (Chandola 2009). These areas are not affected by the Indian monsoon as they are positioned in the rain shadow of the main Himalayan

region and characterized by extreme climatic conditions, such as diurnal fluctuations in temperatures, scanty and erratic rainfall, heavy winds and snowfall.

The Indian Trans-Himalaya (ITH) usually described as 'High Altitude Cold Desert Zone' (Zone 1) spreads into three biogeographic provinces: 1A, Ladakh mountains: Kargil, Nubra and Zaskar in Jammu and Kashmir and Lahul and Spiti in Himachal Pradesh); 1B, Tibetan plateau: Changthang region of Ladakh and northern parts of the states of Uttarakhand; and 1C, Sikkim Plateau (Rodgers et al. 2000; WII 2015, unpublished). The vegetation of ITH has been described as *Caragana-Lonicera-Artemisia* formation (Osmaston 1922), alpine steppe (Schweinfurth 1957), dry alpine scrub (Champion and Seth 1968) and alpine stony deserts (Puri et al. 1989). The extreme north of the state of Uttarakhand contributes approximately 1% (ca. >1,000 km²) of the total Trans-Himalayan region of India (ca. 98,660 km²) covering Nilang, Niti and Mana valleys (Nanda Devi Biosphere Reserve) and Johar valley in Uttarkashi, Chamoli and Pithoragarh districts, respectively.

The Nanda Devi Biosphere Reserve (NDBR) located in the state of Uttarakhand, India has been extensively surveyed in terms of flora by Hajra and Balodi (1995) and recorded 801 species of vascular plants covering the then area of reserve ca. 2000 km². The core zones, Nanda Devi National Park (NDNP) and Valley of Flowers National Park (VoFNP), were surveyed by Samant (1993; 656 species of vascular plants) and Kala et al. (1998; 521 species of vascular plants). Joshi and Samant (2004) reported 76 woody species and 13 forest communities from buffer zone of NDBR, Samant and Joshi (2005) recorded 490 plant species from NDNP, Murthy (2011) prepared a pictorial field guide for VoFNP covering 287 species belonging to 190 genera under 63 families and Kumar et al. (2013a) added 16 species of vascular plants to the plant wealth of NDBR. It is noteworthy that although the Great Himalayan range has been thoroughly explored by the botanists, very few

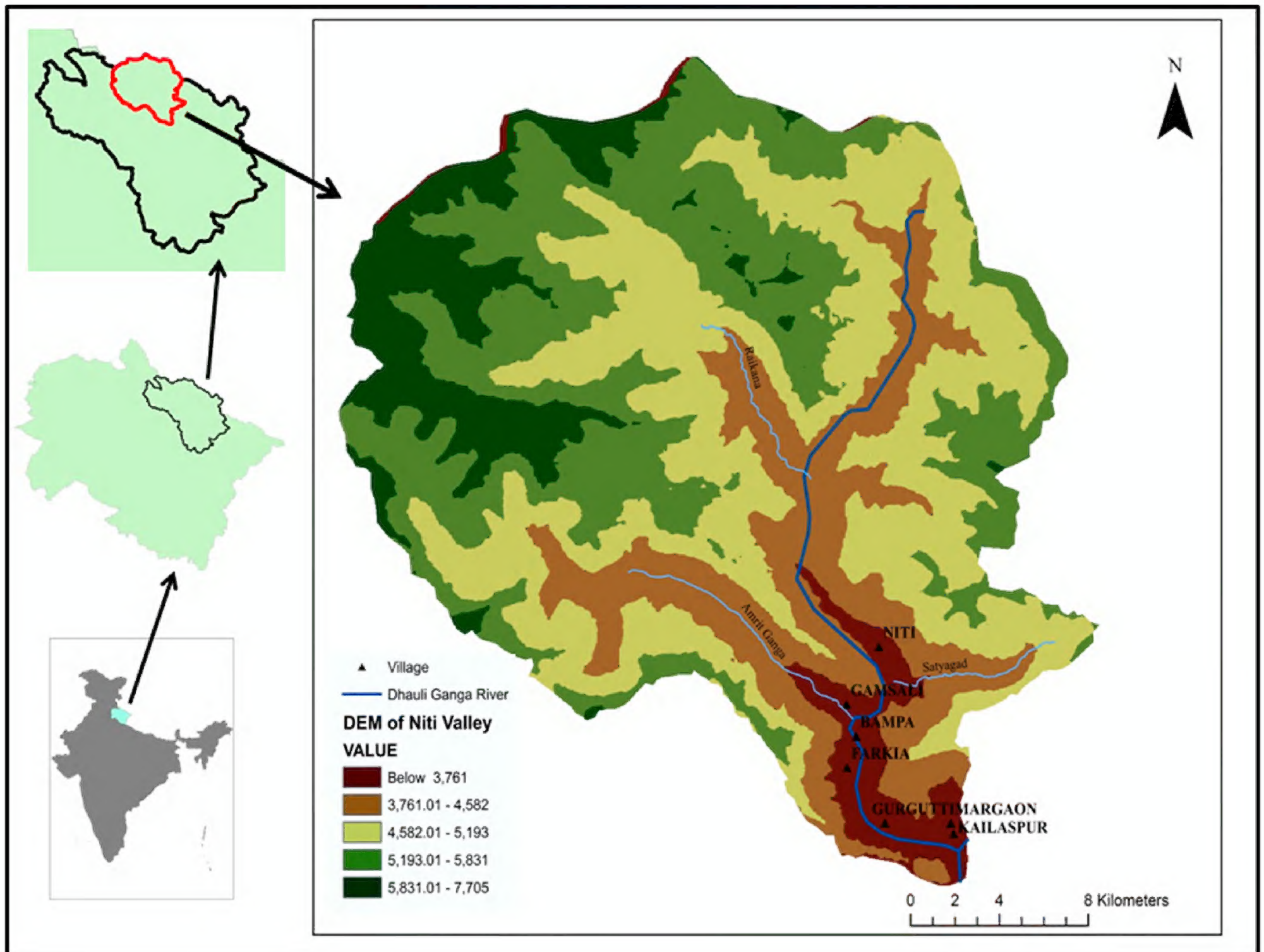


Figure 1. Map showing the location of Niti valley in Nanda Devi Biosphere Reserve, Western Himalaya, India.

floristic surveys in the equally important areas, such as the Trans-Himalayan region, have been conducted, especially in the state of Uttarakhand, except Chandola (2009). Additionally, flora of NDBR has been extensively surveyed by various workers albeit highly confined to the core zones. Therefore, the present study was conducted to assess the diversity of vascular plants in the Niti valley, an extended buffer zone of the Biosphere Reserve which represents the cold arid landscape.

MATERIALS AND METHODS

Study area

Located in the state of Uttarakhand in India, Nanda Devi Biosphere Reserve (ca. 6,407 km², 30°08' to 31°02' N, 079°12' to 080°19' E) has two core zones, Nanda Devi National Park (NDNP; 630 km²) and the Valley of Flowers National Park (VoFNP; 87.5 km²), which are together listed as a world natural heritage site (<http://www.whc.unesco.org>). This study was conducted in the Niti valley, a buffer zone of NDBR, Western Himalaya (Figure 1). The valley with an average elevation ranging from 3,500–5,000 m above mean sea level is spread over

ca. 727.7 km² area. The valley also known as Upper Dhaul valley, is named after the river *Dhaul Ganga* that forms one of the major catchments of river Alaknanda (a sub-catchment of the river Ganga). The picturesque landscape of valley comes under Trans-Himalayan region of the Uttarakhand state in the Western Himalaya. *Bhotiya*, an ethnic community of Indo-Mongoloid origin inhabited in the valley has own perspective on conservation of natural resources for example, *Allium stracheyi* Baker, through local archetypes (Kumar et al. 2013b). The valley has three sub-watersheds: Amrit Ganga, Ganesh Ganga and Satyagad. The important alpine pastures are Dhaman, Bamplas, Kalazowar, Rekhana (base of Mount Kamet), Gothing and Geldung and the area continues to be used for transhumant pastoralism (Mitra et al. 2013). This area is situated in the rain-shadow zone of NDBR and dryness increase towards upper reaches of the valley and Girthi valleys, which remain snow bound for more than 6 months in a year. Summer is very short and generally lasts from June to August. The region receives low amount of precipitation and remains dry and dusty above 3,200 m above mean sea level.

The vegetation of the study area is broadly divisible into following classes: (i) dry temperate forests dominated by blue pine (*Pinus wallichiana* A.B.Jacks.), deodar (*Cedrus deodara* (Roxb. ex D.Don) G.Don) and spruce (*Picea smithiana* Boiss.) in the lower reaches of the valley, (ii) sub-alpine forests dominated by birch (*Betula utilis* D.Don), fir (*Abies pindrow* Spach) and juniper (*Juniperus* spp.), (iii) riverine scrub dominated by species of *Hippophae* L., *Salix* L. and *Myricaria* Desv., (iv) alpine dry scrub (*Caragana* sp., *Juniperus* sp., *Krascheninnikovia ceratoides* (L.) Gueldenst., *Potentilla rigida* Wall. ex Lehm., *Devendraea spinosa* (Decne.) Pusalkar and *Lonicera* spp. and (v) alpine mixed herbaceous formations (*Kobresia* sp., *Trachydium roylei* Lindl., *Danthonia* sp. and *Potentilla* sp.). Most of the area (>70%) falls under alpine dry scrub and alpine mixed herbaceous formations, which is further divisible into several communities depending upon topographic features (elevation, aspect and slope).

Field survey and data collection

Systematic survey of vascular plants was done during the growing season from May to October in 2011, 2012 and 2014. The entire valley was traversed on foot to cover all the landscape features, which included alpine arid tracts, *nallahs*, ridges, exposed and unexposed sites, riverside tracts, valley bottoms, grasslands, agricultural fields, near human habitations and various habitats in and around forests and in the inaccessible areas wherever possible. To facilitate the process of correct identification and the information on parameters such as elevation, aspect, important taxonomic characters including habit and habitat of the species were also gathered. The identification of plant specimens was cross-checked with authentic specimens housed in herbaria (BSD, DD and WII) and based on field characters with the aid of existing florulas and literature (Naithani 1984a, 1984b; Hajra and Balodi 1995; Chandola 2009; Pusalkar and Singh (2012). The currently accepted botanical names and

Table 1. Detailed analysis of floristic diversity under various taxonomic groups (values in parentheses are percent contribution of the total).

Plant Groups	Family	Genera	Species
Dicotyledons	52 (71.2)	208 (78)	383 (77.3)
Monocotyledons	10 (13.6)	43 (16)	93 (18.7)
Pteridophytes	8 (10.9)	9 (3.3)	9 (1.8)
Gymnosperms	3 (4.1)	7 (2.6)	10 (2)
Total	73	267	495

authorities were updated following <http://www.ipni.org> and the families were updated following APG III (2009). The voucher specimens were dried, pressed and mounted on herbarium sheets following Jain and Rao (1976) and deposited in the herbarium of Wildlife Institute of India, Dehradun (WII) for future reference and records. The plant species including threatened or common, which were easily identified in the field were only photographed. The threat status of species was also determined with the aid of existing literature (Nayar and Sastry 1987–90; Walter and Gillett 1998; Ved et al. 2003; Hedge et al. 2003 and Srivastava 2010). Species richness was determined as the total number of the species in an area.

RESULTS

Floristic diversity and richness

The systematic floristic survey and detailed inventory of the entire area revealed presence of 495 species of vascular plants (angiosperms, gymnosperms and pteridophytes) belonging to 267 genera and 73 families (Table 1). Of the recorded species, 383 were dicots, 93 monocots, 9 pteridophytes and 10 gymnosperms. The valley comprises 62% of the vascular plants of NDBR and 35% of the flora of cold deserts of Western Himalaya. The current documentation also updates the flora of NDBR with new distributional records of 167 species (Table 2, asterisked). The ratio of monocots to dicots in respect of families, genera and species is 1:5.6, 1:4.7 and 1:4, respectively. The dominant families in terms of high

Table 2. List of vascular plants recorded in Niti Valley, Nanda Devi Biosphere Reserve, Western Himalaya, India. Abbreviations: H=Herb, S=Shrub, T=Tree, C=Climber, F=Fern, O=Orchids, G=Grass and Sd=Sedge. *=new distributional records for Nanda Devi Biosphere Reserve, India.

Plant group	Family	Growth form	Source	Voucher number
Angiosperms				
* <i>Acroglochin persicarioides</i> Moq.	Amaranthaceae	H	Pusalkar and Singh (2012)	WII0100P
<i>Axyris hybrida</i> L.	Amaranthaceae	H	Pusalkar and Singh (2012)	WII0101P
<i>Chenopodium botrys</i> L.	Amaranthaceae	H	Pusalkar and Singh (2012)	WII0102P
<i>Chenopodium foliosum</i> Asch.	Amaranthaceae	H	Pusalkar and Singh (2012)	WII0103P
<i>Chenopodium hybridum</i> L.	Amaranthaceae	H	Pusalkar and Singh (2012)	WII0104P
<i>Chenopodium opulifolium</i> Schrad. ex W.D.J.Koch & Ziz	Amaranthaceae	H	Pusalkar and Singh (2012)	WII0105P
* <i>Krascheninnikovia ceratoides</i> (L.) Gueldenst.	Amaranthaceae	S	Pusalkar and Singh (2012)	WII20851
* <i>Allium carolinianum</i> DC.	Amaryllidaceae	H	Murti (2001)	WII20601
<i>Allium stracheyi</i> Baker	Amaryllidaceae	H	Murti (2001)	WII20866
<i>Allium wallichii</i> Kunth	Amaryllidaceae	H	Murti (2001)	WII0012P

Continued

Table 2. Continued.

Plant group	Family	Growth form	Source	Voucher number
* <i>Angelica archangelica</i> L.	Apiaceae	H	Hajra and Balodi (1995)	WII0174P
* <i>Angelica glauca</i> Edgew.	Apiaceae	H	Pusalkar and Singh (2012)	WII00217701320
<i>Bupleurum candollei</i> Wall. ex DC.	Apiaceae	H	Pusalkar and Singh (2012)	WII20683
<i>Bupleurum falcatum</i> L.	Apiaceae	H	Pusalkar and Singh (2012)	WII0175P
<i>Bupleurum lanceolatum</i> Wall. ex DC.	Apiaceae	H	Pusalkar and Singh (2012)	WII0176P
* <i>Bupleurum longicaule</i> Wall. ex DC.	Apiaceae	H	Pusalkar and Singh (2012)	WII20644
* <i>Carum carvi</i> L.	Apiaceae	H	Pusalkar and Singh (2012)	WII0177P
<i>Chaerophyllum reflexum</i> Lindl.	Apiaceae	H	Pusalkar and Singh (2012)	WII20635
<i>Eriocyca caespitosa</i> H.Wolff	Apiaceae	H	Pusalkar and Singh (2012)	WII20670
* <i>Heracleum candicans</i> Wall. ex DC.	Apiaceae	H	Pusalkar and Singh (2012)	WII0178P
* <i>Heracleum pinnatum</i> C.B.Clarke	Apiaceae	H	Pusalkar and Singh (2012)	WII0179P
* <i>Pleurospermum brunonis</i> Benth. ex C.B.Clarke	Apiaceae	H	Pusalkar and Singh (2012)	WII0180P
* <i>Pleurospermum candollei</i> (DC.) Benth. ex C.B.Clarke	Apiaceae	H	Pusalkar and Singh (2012)	WII00000001356
<i>Pleurospermum stellatum</i> Benth. ex C.B.Clarke	Apiaceae	H	Pusalkar and Singh (2012)	WII20689
<i>Selinum candollei</i> Edgew.	Apiaceae	H	Pusalkar and Singh (2012)	WII0181P
<i>Selinum wallichianum</i> (DC.) Raizada & Saxena	Apiaceae	H	Pusalkar and Singh (2012)	WII0182P
<i>Trachydium roylei</i> Lindl.	Apiaceae	H	Pusalkar and Singh (2012)	WII20805
<i>Vicatia coniifolia</i> DC.	Apiaceae	H	Pusalkar and Singh (2012)	WII00000001364
* <i>Cynanchum auriculatum</i> Royle ex Wight	Apocynaceae	C	Pusalkar and Singh (2012)	WII0119P
* <i>Cynanchum vincetoxicum</i> Pers.	Apocynaceae	H	Pusalkar and Singh (2012)	WII00401502082
<i>Arisaema flavum</i> Schott.	Araceae	H	Pusalkar and Singh (2012)	WII0001P
<i>Arisaema jacquemontii</i> Blume	Araceae	H	Murti (2001)	WII0002P
<i>Asparagus filicinus</i> Buch.-Ham. ex D.Don	Asparagaceae	H	Hajra and Balodi (1995)	WII0012P
<i>Polygonatum cirrhifolium</i> Royle	Asparagaceae	H	Pusalkar and Singh (2012)	WII00632903303
<i>Polygonatum graminifolium</i> Hook.	Asparagaceae	H	Pusalkar and Singh (2012)	WII20898
<i>Polygonatum verticillatum</i> All.	Asparagaceae	H	Pusalkar and Singh (2012)	WII20624
* <i>Ajania tibetica</i> (Hook.f. & Thomson) Tzvelev	Asteraceae	H	www.efloras.org	WII20832
<i>Anaphalis nepalensis</i> (Spreng.) Hand.-Mazz.	Asteraceae	H	Pusalkar and Singh (2012)	WII0142P
* <i>Anaphalis nubigena</i> DC.	Asteraceae	H	Pusalkar and Singh (2012)	WII20700
<i>Anaphalis royleana</i> DC.	Asteraceae	H	Pusalkar and Singh (2012)	WII20876
<i>Anaphalis triplinervis</i> Sims ex C.B.Clarke	Asteraceae	H	Pusalkar and Singh (2012)	WII00248601590
* <i>Anaphalis xylorhiza</i> Sch.-Bip. ex Hook.f.	Asteraceae	H	Pusalkar and Singh (2012)	WII0143P
<i>Arctium lappa</i> L.	Asteraceae	H	Pusalkar and Singh (2012)	WII0144P
<i>Artemisia capillaris</i> Thunb.	Asteraceae	H	Hajra and Balodi (1995)	WII00293501609
* <i>Artemisia edgeworthii</i> N.P.Balakr.	Asteraceae	H	Pusalkar and Singh (2012)	WII20880
<i>Artemisia gmelinii</i> Weber ex Steckm. var. <i>gmelinii</i>	Asteraceae	H	Pusalkar and Singh (2012)	WII20871
* <i>Artemisia macrocephala</i> Jacquem. ex Besser	Asteraceae	H	Pusalkar and Singh (2012)	WII00286501598
<i>Artemisia maritima</i> L.	Asteraceae	H	Hajra and Balodi (1995)	WII0146P
* <i>Artemisia salsoloides</i> Willd.	Asteraceae	H	Pusalkar and Singh (2012)	WII0147P
<i>Artemisia</i> sp.	Asteraceae	H	Pusalkar and Singh (2012)	WII20641
* <i>Artemisia vestita</i> Wall.	Asteraceae	H	Pusalkar and Singh (2012)	WII0145P
<i>Aster albescens</i> (DC.) Wall. ex Hand.-Mazz.	Asteraceae	H	Pusalkar and Singh (2012)	WII0148P
<i>Aster flaccidus</i> Bunge	Asteraceae	H	Pusalkar and Singh (2012)	WII20844
* <i>Brachyactis menthodora</i> Benth.	Asteraceae	H	Pusalkar and Singh (2012)	WII0198P
* <i>Brachyactis pubescens</i> Aitch. & Clarke	Asteraceae	H	Pusalkar and Singh (2012)	WII0149P
<i>Brachyactis roylei</i> (DC.) Wendelbo	Asteraceae	H	Pusalkar and Singh (2012)	WII00256101644
<i>Carduus edelbergii</i> Rech.f.	Asteraceae	H	Pusalkar and Singh (2012)	WII0150P
<i>Cicerbita macrorhiza</i> Beauverd	Asteraceae	H	Pusalkar and Singh (2012)	WII00344301665
* <i>Cicerbita violifolia</i> Beauverd	Asteraceae	H	www.efloras.org	WII0151P
<i>Cirsium wallichii</i> DC.	Asteraceae	H	Pusalkar and Singh (2012)	WII0152P
<i>Cousinia thomsonii</i> C.B.Clarke	Asteraceae	H	Pusalkar and Singh (2012)	WII0153P
<i>Cremanthodium arnicoides</i> R.D.Good	Asteraceae	H	Pusalkar and Singh (2012)	WII0154P
<i>Crepis flexuosa</i> (Ledeb.) Benth. ex C.B.Clarke	Asteraceae	H	Pusalkar and Singh (2012)	WII20663
<i>Dolomiaea macrocephala</i> DC.	Asteraceae	H	Pusalkar and Singh (2012)	WII20892
<i>Dubyaea hispida</i> DC.	Asteraceae	H	Pusalkar and Singh (2012)	WII0155P
<i>Echinops cornigerus</i> DC.	Asteraceae	H	Pusalkar and Singh (2012)	WII00366801687
<i>Erigeron acris</i> L.	Asteraceae	H	Pusalkar and Singh (2012)	WII20877
<i>Erigeron multiradiatus</i> (Lindl. ex DC.) Benth. ex C.B.Clarke	Asteraceae	H	Pusalkar and Singh (2012)	WII00249401721
<i>Gerbera gossypina</i> Beauverd	Asteraceae	H	Hajra and Balodi (1995)	WII00422001732
* <i>Hippolytia senecionis</i> Poljakov ex Tzvelev	Asteraceae	H	Pusalkar and Singh (2012)	WII0156P
* <i>Inula grandiflora</i> Willd.	Asteraceae	H	Pusalkar and Singh (2012)	WII0157P

Continued

Table 2. Continued.

Plant group	Family	Growth form	Source	Voucher number
<i>Lactuca dolichophylla</i> Kitam.	Asteraceae	H	Pusalkar and Singh (2012)	WII0158P
<i>Leontopodium brachyactis</i> Gand.	Asteraceae	H	Pusalkar and Singh (2012)	WII20887
* <i>Leontopodium nanum</i> (Hook.f. & Thomson ex C.B.Clarke) Hand.-Mazz.	Asteraceae	H	Pusalkar and Singh (2012)	WII20680
<i>Myriactis javanica</i> DC.	Asteraceae	H	Hajra and Balodi (1995)	WII0159P
* <i>Petasites tricholobus</i> Franch.	Asteraceae	H	Pusalkar and Singh (2012)	WII0207P
<i>Picris hieracioides</i> L.	Asteraceae	H	Pusalkar and Singh (2012)	WII0160P
<i>Prenanthes brunoniana</i> Wall. ex DC.	Asteraceae	H	Pusalkar and Singh (2012)	WII00526201725
<i>Prenanthes violifolia</i> Decne.	Asteraceae	H	Hajra and Balodi (1995)	WII0161P
* <i>Saussurea abnormis</i> Lipsch.	Asteraceae	H	www.efloras.org	WII0162P
<i>Saussurea albescens</i> (DC.) Sch.Bip.	Asteraceae	H	Pusalkar and Singh (2012)	WII20882
<i>Saussurea costus</i> (Falc.) Lipsch.	Asteraceae	H	Pusalkar and Singh (2012)	WII0211P
* <i>Saussurea nana</i> (Pamp.) Pamp.	Asteraceae	H	www.efloras.org	WII20860
<i>Saussurea obvallata</i> Wall.	Asteraceae	H	Pusalkar and Singh (2012)	WII20874
* <i>Senecio dubitabilis</i> C.Jeffrey & Y.L.Chen	Asteraceae	H	Pusalkar and Singh (2012)	WII0163P
<i>Senecio krascheninnikovii</i> Schischk.	Asteraceae	H	Pusalkar and Singh (2012)	WII0164P
* <i>Senecio kunthianus</i> Wall.	Asteraceae	H	Pusalkar and Singh (2012)	WII0165P
<i>Senecio laetus</i> Edgew.	Asteraceae	H	Pusalkar and Singh (2012)	WII0166P
<i>Solidago virga-aurea</i> Auct.	Asteraceae	H	Pusalkar and Singh (2012)	WII00338101799
<i>Sonchus oleraceus</i> L.	Asteraceae	H	Pusalkar and Singh (2012)	WII0167P
<i>Taraxacum officinale</i> F.H.Wigg.	Asteraceae	H	Pusalkar and Singh (2012)	WII00640601811
<i>Tussilago farfara</i> L.	Asteraceae	H	Pusalkar and Singh (2012)	WII0168P
<i>Waldheimia glabra</i> Regel	Asteraceae	H	Pusalkar and Singh (2012)	WII0169P
<i>Waldheimia tomentosa</i> Regel	Asteraceae	H	Pusalkar and Singh (2012)	WII20864
* <i>Impatiens badrinathii</i> Pusalkar & D.K.Singh	Balsaminaceae	H	Pusalkar and Singh (2012)	WII0203P
* <i>Impatiens brachycentra</i> Kar. & Kir.	Balsaminaceae	H	Pusalkar and Singh (2012)	WII0204P
<i>Impatiens scabrida</i> DC.	Balsaminaceae	H	Pusalkar and Singh (2012)	WII20652
<i>Impatiens</i> sp.	Balsaminaceae	H	Pusalkar and Singh (2012)	WII0106P
<i>Impatiens sulcata</i> Wall.	Balsaminaceae	H	Pusalkar and Singh (2012)	WII0107P
<i>Berberis pseudumbellata</i> R.Parker	Berberidaceae	S	Pusalkar and Singh (2012)	WII20821
<i>Berberis jaeschkeana</i> Schneider	Berberidaceae	S	Pusalkar and Singh (2012)	WII20820
<i>Sinopodophyllum hexandrum</i> (Royle) T.S.Ying	Berberidaceae	H	Pusalkar and Singh (2012)	WII00005000099
<i>Betula utilis</i> D.Don	Betulaceae	T	Pusalkar and Singh (2012)	WII00297803129
<i>Incarvillea arguta</i> Royle	Bignoniaceae	H	Hajra and Balodi (1995)	WII0139P
<i>Arnebia benthamii</i> (Wall. ex G.Don) I.M.Johnst.	Boraginaceae	H	Pusalkar and Singh (2012)	WII20886
<i>Arnebia euchroma</i> (Royle ex Benth.) I.M.Johnst.	Boraginaceae	H	Pusalkar and Singh (2012)	WII20686
<i>Cynoglossum glochidiatum</i> Benth.	Boraginaceae	H	Pusalkar and Singh (2012)	WII0120P
<i>Eritrichium canum</i> (Benth.) Kitam.	Boraginaceae	H	Pusalkar and Singh (2012)	WII20681
<i>Hackelia uncinata</i> (Royle ex Benth.) C.E.C.Fisch.	Boraginaceae	H	Pusalkar and Singh (2012)	WII0121P
* <i>Lappula barbata</i> Gürke	Boraginaceae	H	Pusalkar and Singh (2012)	WII20863
* <i>Lindelofia stylosa</i> (Kar. & Kir.) Brand	Boraginaceae	H	Pusalkar and Singh (2012)	WII00000002194
* <i>Arabis amplexicaulis</i> Edgew.	Brassicaceae	H	Pusalkar and Singh (2012)	WII0078P
* <i>Brassica campestris</i> L.	Brassicaceae	H	Pusalkar and Singh (2012)	WII0079P
<i>Capsella bursa-pastoris</i> (L.) Medik.	Brassicaceae	H	Pusalkar and Singh (2012)	WII0214P
* <i>Chorispora sabulosa</i> Cambess.	Brassicaceae	H	www.efloras.org	WII20833
<i>Crucihimalaya himalaica</i> (Edgew.) Al-Shehbaz, O'Kane & R.A.Price	Brassicaceae	H	Pusalkar and Singh (2012)	WII20605
* <i>Descurainia sophia</i> (L.) Webb ex Prantl	Brassicaceae	H	Pusalkar and Singh (2012)	WII0080P
* <i>Dontostemon glandulosus</i> (Kar. & Kir.) O.E.Schulz	Brassicaceae	H	www.efloras.org	WII0202P
<i>Draba altaica</i> Bunge	Brassicaceae	H	Pusalkar and Singh (2012)	WII20848
<i>Erysimum hieraciifolium</i> L.	Brassicaceae	H	Pusalkar and Singh (2012)	WII20849
<i>Lepidium apetalum</i> Willd.	Brassicaceae	H	Pusalkar and Singh (2012)	WII0215P
* <i>Parrya nudicaulis</i> (L.) Regel	Brassicaceae	H	Pusalkar and Singh (2012)	WII20603
<i>Turritis glabra</i> L.	Brassicaceae	H	Pusalkar and Singh (2012)	WII20602
* <i>Campanula argyrotricha</i> Wall. & DC.	Campanulaceae	H	Pusalkar and Singh (2012)	WII0140P
* <i>Campanula aristata</i> Wall.	Campanulaceae	H	Pusalkar and Singh (2012)	WII20654
<i>Campanula pallida</i> Wall.	Campanulaceae	H	Pusalkar and Singh (2012)	WII0199P
<i>Codonopsis rotundifolia</i> Royle	Campanulaceae	C	Pusalkar and Singh (2012)	WII21971
* <i>Cyananthus linifolius</i> Wall. ex Hook.f. & Thomson	Campanulaceae	H	Pusalkar and Singh (2012)	WII0141P
<i>Cannabis sativa</i> L.	Cannabaceae	H	Pusalkar and Singh (2012)	WII0067P
<i>Abelia triflora</i> R.Br.	Caprifoliaceae	S	Pusalkar and Singh (2012)	WII00403301389
<i>Devendraea myrtillus</i> (Hook.f. & Thomson) Pusalkar	Caprifoliaceae	S	Pusalkar and Singh (2012)	WII20629
<i>Devendraea spinosa</i> (Decne.) Pusalkar	Caprifoliaceae	S	Pusalkar and Singh (2012)	WII20630

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Table 2. Continued.

Plant group	Family	Growth form	Source	Voucher number
<i>Lonicera hypoleuca</i> Decne.	Caprifoliaceae	S	Pusalkar and Singh (2012)	WII0170P
<i>Lonicera obovata</i> Royle ex Hook.f. & Thomson	Caprifoliaceae	S	Pusalkar and Singh (2012)	WII0171P
* <i>Lonicera quinquelocularis</i> Hardw.	Caprifoliaceae	S	Pusalkar and Singh (2012)	WII20643
<i>Lonicera webbia</i> Wall.	Caprifoliaceae	S	Pusalkar and Singh (2012)	WII20873
* <i>Lonicera asperifolia</i> Hook.f. & Thomson	Caprifoliaceae	S	Pusalkar and Singh (2012)	WII20628
<i>Morina coulteriana</i> Royle	Caprifoliaceae	H	Pusalkar and Singh (2012)	WII0172P
<i>Morina longifolia</i> Wall. ex DC.	Caprifoliaceae	H	Pusalkar and Singh (2012)	WII0173P
<i>Valeriana hardwickii</i> Wall.	Caprifoliaceae	H	Pusalkar and Singh (2012)	WII20660
<i>Viburnum cotinifolium</i> D.Don	Caprifoliaceae	S	Pusalkar and Singh (2012)	WII00479501412
<i>Arenaria serpyllifolia</i> L.	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII0197P
<i>Arenaria festuoides</i> Benth.	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII20865
<i>Arenaria perlevis</i> Hand.-Mazz.	Caryophyllaceae	H	Hajra and Balodi (1995)	WII0093P
* <i>Cerastium</i> sp.	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII0200P
<i>Gypsophila cerastioides</i> D.Don	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII20870
<i>Silene edgeworthii</i> Bocquet	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII0094P
<i>Silene gonosperma</i> (Rupr.) Bocquet	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII20878
<i>Silene indica</i> Roxb. ex Otth	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII20637
* <i>Silene moorcroftiana</i> Wall.	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII20684
* <i>Silene setaesperma</i> Majumdar	Caryophyllaceae	H	www.efloras.org	WII0095P
<i>Silene viscosa</i> Pers.	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII0096P
<i>Silene vulgaris</i> (Moench) Garcke	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII0097P
<i>Stellaria decumbens</i> Edgew.	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII0098P
<i>Stellaria monosperma</i> Buch.-Ham. ex D.Don	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII00852600239
<i>Stellera chamaejasme</i> L.	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII0099P
<i>Thylacospermum caespitosum</i> (Cambess.) Schischk.	Caryophyllaceae	H	Pusalkar and Singh (2012)	WII20894
<i>Parnassia nubicola</i> Wall.	Celastraceae	H	Pusalkar and Singh (2012)	WII00522901160
<i>Convolvulus arvensis</i> L.	Convolvulaceae	C	Pusalkar and Singh (2012)	WII00553302208
<i>Cuscuta europaea</i> L. var. <i>indica</i> Engelm.	Convolvulaceae	C	Pusalkar and Singh (2012)	WII00285402237
* <i>Cuscuta reflexa</i> Roxb.	Convolvulaceae	C	Pusalkar and Singh (2012)	WII0122P
* <i>Hylotelephium ewersii</i> (Ledeb.) H.Ohba	Crassulaceae	H	Pusalkar and Singh (2012)	WII20868
<i>Rhodiola heterodonta</i> (Hook.f. & Thomson) Boriss.	Crassulaceae	H	Pusalkar and Singh (2012)	WII20693
<i>Rhodiola imbricata</i> Edgew.	Crassulaceae	H	Pusalkar and Singh (2012)	WII0036P
<i>Rhodiola quadrifida</i> Fisch. & C.A.Mey.	Crassulaceae	H	Pusalkar and Singh (2012)	WII20692
<i>Rhodiola wallichiana</i> (Hook.) Fu	Crassulaceae	H	Pusalkar and Singh (2012)	WII0038P
* <i>Rosularia alpestris</i> (Kar. & Kir.) Boriss.	Crassulaceae	H	Pusalkar and Singh (2012)	WII0039P
<i>Sedum multicaule</i> Wall. ex Lindl.	Crassulaceae	H	Pusalkar and Singh (2012)	WII00527501173
<i>Sedum trullipetalum</i> Hook.f. & Thomson	Crassulaceae	H	Pusalkar and Singh (2012)	WII0040P
* <i>Tillaea pharnaceoides</i> Hochst. ex Steud.	Crassulaceae	H	www.efloras.org	WII0041P
* <i>Blymus compressus</i> (L.) Panz. ex Link	Cyperaceae	Sd	Murti (2001)	WII21996
* <i>Carex cruenta</i> Nees	Cyperaceae	Sd	Murti (2001)	WII0014P
* <i>Carex gracilentia</i> Boott ex Boeckeler	Cyperaceae	Sd	Murti (2001)	WII21999
<i>Carex lehmannii</i> Drejer	Cyperaceae	Sd	Murti (2001)	WII20620
<i>Carex nivalis</i> Boott	Cyperaceae	Sd	Murti (2001)	WII20621
<i>Carex nubigena</i> D.Don	Cyperaceae	Sd	Pusalkar and Singh (2012)	WII21989
* <i>Carex orbicularis</i> Boott	Cyperaceae	Sd	Murti (2001)	WII20807
* <i>Carex sagaensis</i> Y.C.Yang	Cyperaceae	Sd	www.efloras.org	WII20818
<i>Carex</i> sp.	Cyperaceae	Sd	Murti (2001)	WII22004
<i>Carex</i> sp.	Cyperaceae	Sd	Murti (2001)	WII22011
<i>Kobresia capillifolia</i> (Decne.) C.B.Clarke	Cyperaceae	Sd	Murti (2001)	WII0015P
<i>Kobresia laxa</i> Nees	Cyperaceae	Sd	Murti (2001)	WII0016P
<i>Kobresia nepalensis</i> (Nees) Kuk.	Cyperaceae	Sd	Murti (2001)	WII0017P
* <i>Kobresia nitens</i> C.B.Clarke	Cyperaceae	Sd	Murti (2001)	WII20836
* <i>Kobresia pygmaea</i> (C.B.Clarke) C.B.Clarke	Cyperaceae	Sd	Murti (2001)	WII20815
<i>Kobresia royleana</i> (Nees) Nees ex Boeckeler	Cyperaceae	Sd	Murti (2001)	WII21994
<i>Kobresia</i> sp.	Cyperaceae	Sd	Murti (2001)	WII22003
<i>Kobresia</i> sp.	Cyperaceae	Sd	Murti (2001)	WII22009
<i>Kobresia</i> sp.	Cyperaceae	Sd	Murti (2001)	WII22009
<i>Dioscorea deltoidea</i> Wall.	Dioscoreaceae	C	Murti (2001)	WII00850503272
<i>Hippophae salicifolia</i> D.Don	Elaeagnaceae	S	Pusalkar and Singh (2012)	WII00338002902
<i>Hippophae tibetana</i> Schltdl.	Elaeagnaceae	S	Pusalkar and Singh (2012)	WII0065P
<i>Cassiope fastigiata</i> D.Don	Ericaceae	S	Pusalkar and Singh (2012)	WII0110P

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Table 2. Continued.

Plant group	Family	Growth form	Source	Voucher number
<i>Gaultheria trichophylla</i> Royle	Ericaceae	S	Pusalkar and Singh (2012)	WII00645501874
<i>Monotropa hypopitys</i> L.	Ericaceae	H	Pusalkar and Singh (2012)	WII0111P
<i>Rhododendron anthopogon</i> D.Don	Ericaceae	S	Pusalkar and Singh (2012)	WII20884
<i>Rhododendron campanulatum</i> D.Don	Ericaceae	S	Pusalkar and Singh (2012)	WII00594601889
<i>Rhododendron lepidotum</i> Wall. ex G.Don	Ericaceae	S	Pusalkar and Singh (2012)	WII00343001891
<i>Euphorbia</i> sp.	Euphorbiaceae	H	Pusalkar and Singh (2012)	WII20804
<i>Euphorbia stracheyi</i> Boiss.	Euphorbiaceae	H	Pusalkar and Singh (2012)	WII20801
<i>Astragalus candolleanus</i> Boiss.	Fabaceae	S	Pusalkar and Singh (2012)	WII0042P
<i>Astragalus chlorostachys</i> Lindl.	Fabaceae	H	Hajra and Balodi (1995)	WII00850900696
* <i>Astragalus densiflorus</i> Kar. & Kir.	Fabaceae	H	Chandola (2009)	WII20685
<i>Astragalus himalayanus</i> Klotzsch	Fabaceae	H	Pusalkar and Singh (2012)	WII20646
* <i>Astragalus lessertioides</i> Benth. ex Bunge	Fabaceae	H	Pusalkar and Singh (2012)	WII20668
* <i>Astragalus rhizanthus</i> Royle ex Benth.	Fabaceae	H	Pusalkar and Singh (2012)	WII20855
* <i>Caragana gerardiana</i> Benth.	Fabaceae	S	Pusalkar and Singh (2012)	WII0043P
<i>Caragana versicolor</i> Benth.	Fabaceae	S	Pusalkar and Singh (2012)	WII20697
<i>Cicer microphyllum</i> Royle	Fabaceae	H	Pusalkar and Singh (2012)	WII20899
* <i>Lespedeza juncea</i> (L.f.) Pers.	Fabaceae	H	Pusalkar and Singh (2012)	WII00528000841
* <i>Medicago edgeworthii</i> Sirj.	Fabaceae	H	Pusalkar and Singh (2012)	WII0206P
<i>Oxytropis lapponica</i> Gaudin.	Fabaceae	H	Pusalkar and Singh (2012)	WII00000000862
* <i>Oxytropis microphylla</i> DC.	Fabaceae	H	Pusalkar and Singh (2012)	WII00000000863
* <i>Oxytropis</i> sp.	Fabaceae	H	Pusalkar and Singh (2012)	WII20664
<i>Parochetus communis</i> Buch.-Ham. ex D.Don	Fabaceae	H	Pusalkar and Singh (2012)	WII00335300866
* <i>Phaseolus vulgaris</i> L.	Fabaceae	H	Naithani (1984)	WII0044P
* <i>Pisum sativum</i> L.	Fabaceae	H	Naithani (1984)	WII0045P
* <i>Spongiocarpella nubigena</i> (D.Don) Yakovlev	Fabaceae	H	Pusalkar and Singh (2012)	WII20667
<i>Thermopsis barbata</i> Benth.	Fabaceae	H	Pusalkar and Singh (2012)	WII0046P
<i>Tibetia himalaica</i> (Baker) H.P.Tsui	Fabaceae	H	Pusalkar and Singh (2012)	WII20824
* <i>Trifolium repens</i> L.	Fabaceae	H	Pusalkar and Singh (2012)	WII00478800901
<i>Trigonella emodi</i> Benth.	Fabaceae	H	Pusalkar and Singh (2012)	WII20632
<i>Gentiana aprica</i> Decne.	Gentianaceae	H	Hajra and Balodi (1995)	WII00131902119
<i>Gentiana argentea</i> Royle ex D.Don	Gentianaceae	H	Pusalkar and Singh (2012)	WII00646602123
<i>Gentiana stipitata</i> Edgew.	Gentianaceae	H	Pusalkar and Singh (2012)	WII00252202131
<i>Gentiana venusta</i> Wall.	Gentianaceae	H	Pusalkar and Singh (2012)	WII0115P
* <i>Gentiana tianschanica</i> Rupr.	Gentianaceae	H	Pusalkar and Singh (2012)	WII0116P
* <i>Gentianella tenella</i> (Rottb.) Harry Sm.	Gentianaceae	H	Pusalkar and Singh (2012)	WII20893
<i>Halenia elliptica</i> D.Don	Gentianaceae	H	Pusalkar and Singh (2012)	WII0117P
<i>Lomatogonium carinthiacum</i> (Wulfen) Rchb.	Gentianaceae	H	Pusalkar and Singh (2012)	WII0118P
<i>Swertia ciliata</i> (G.Don) B.L.Burt	Gentianaceae	H	Pusalkar and Singh (2012)	WII00251802135
* <i>Swertia petiolata</i> Royle	Gentianaceae	H	Pusalkar and Singh (2012)	WII00342602143
* <i>Geranium collinum</i> Stephan ex Willd.	Geraniaceae	H	Pusalkar and Singh (2012)	WII0071P
* <i>Geranium himalayense</i> Klotzsch	Geraniaceae	H	Pusalkar and Singh (2012)	WII0072P
<i>Geranium nepalense</i> Sweet	Geraniaceae	H	Pusalkar and Singh (2012)	WII00400100428
<i>Geranium wallichianum</i> D.Don	Geraniaceae	H	Pusalkar and Singh (2012)	WII00344000437
<i>Ribes alpestre</i> Wall. ex Decne.	Grossulariaceae	S	Pusalkar and Singh (2012)	WII0030P
<i>Ribes orientale</i> Desf.	Grossulariaceae	S	Pusalkar and Singh (2012)	WII0031P
<i>Deutzia compacta</i> Craib	Hydrangeaceae	S	Pusalkar and Singh (2012)	WII20647
* <i>Hypericum japonicum</i> Thunb.	Hypericaceae	H	Pusalkar and Singh (2012)	WII0070P
<i>Iris kemaonensis</i> D.Don	Iridaceae	H	Murti (2001)	WII0011P
<i>Juglans regia</i> L.	Juglandaceae	T	Hajra and Balodi (1995)	WII00331403123
<i>Juncus himalensis</i> Klotzsch	Juncaceae	Sd	Pusalkar and Singh (2012)	WII00250503321
<i>Juncus</i> sp.	Juncaceae	Sd	Murti (2001)	WII22007
<i>Juncus</i> sp.	Juncaceae	Sd	Murti (2001)	WII20816
<i>Juncus thomsonii</i> Buchenau	Juncaceae	Sd	Murti (2001)	WII20858
* <i>Juncus triglumis</i> L.	Juncaceae	Sd	Murti (2001)	WII22006
<i>Luzula spicata</i> (L.) DC.	Juncaceae	Sd	Murti (2001)	WII20810
<i>Clinopodium umbrosum</i> (M.Bieb.) Kuntze	Lamiaceae	H	Pusalkar and Singh (2012)	WII20634
* <i>Clinopodium vulgare</i> L.	Lamiaceae	H	Pusalkar and Singh (2012)	WII00508002567
<i>Dracocephalum heterophyllum</i> Benth.	Lamiaceae	H	Pusalkar and Singh (2012)	WII20837
<i>Elsholtzia eriostachya</i> Benth.	Lamiaceae	H	Pusalkar and Singh (2012)	WII00260702580
<i>Elsholtzia strobilifera</i> Benth.	Lamiaceae	H	Pusalkar and Singh (2012)	WII00595302585
* <i>Eriophyton rhomboideum</i> (Benth.) Ryding	Lamiaceae	H	Pusalkar and Singh (2012)	WII20682

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Table 2. Continued.

Plant group	Family	Growth form	Source	Voucher number
<i>Hyssopus officinalis</i> L.	Lamiaceae	H	Pusalkar and Singh (2012)	WII0133P
* <i>Leonurus cardiaca</i> L.	Lamiaceae	H	Pusalkar and Singh (2012)	WII20651
<i>Mentha longifolia</i> (L.) Huds.	Lamiaceae	H	Pusalkar and Singh (2012)	WII0134P
<i>Nepeta discolor</i> Royle ex Benth.	Lamiaceae	H	Pusalkar and Singh (2012)	WII00287702622
<i>Nepeta laevigata</i> (D.Don) Hand.-Mazz.	Lamiaceae	H	Pusalkar and Singh (2012)	WII0135P
<i>Nepeta leucophylla</i> Benth.	Lamiaceae	H	Pusalkar and Singh (2012)	WII20608
<i>Origanum vulgare</i> L.	Lamiaceae	H	Pusalkar and Singh (2012)	WII00509902634
<i>Phlomis bracteosa</i> Royle ex Benth.	Lamiaceae	H	Pusalkar and Singh (2012)	WII00000002647
<i>Prunella vulgaris</i> L.	Lamiaceae	H	Pusalkar and Singh (2012)	WII00597202663
<i>Salvia nubicola</i> Wall. ex Sweet	Lamiaceae	H	Pusalkar and Singh (2012)	WII0136P
<i>Scutellaria prostrata</i> Jacquem. ex Benth.	Lamiaceae	H	Pusalkar and Singh (2012)	WII0137P
* <i>Stachys melissifolia</i> Benth.	Lamiaceae	H	Pusalkar and Singh (2012)	WII20675
<i>Thymus linearis</i> Benth.	Lamiaceae	H	Pusalkar and Singh (2012)	WII20872
* <i>Gagea lutea</i> Ker Gawl.	Liliaceae	H	Pusalkar and Singh (2012)	WII0003P
<i>Lloydia serotina</i> (L.) Sweet	Liliaceae	H	Pusalkar and Singh (2012)	WII20689
* <i>Nomocharis oxypetala</i> E.H.Wilson	Liliaceae	H	Pusalkar and Singh (2012)	WII0004P
<i>Malva verticillata</i> L.	Malvaceae	H	Pusalkar and Singh (2012)	WII0076P
* <i>Malva verticillata</i> L. var. <i>crispa</i> L.	Malvaceae	H	Pusalkar and Singh (2012)	WII0077P
<i>Aletris pauciflora</i> (Klotzsch) Hand.-Mazz.	Nartheciaceae	H	Hajra and Balodi (1995)	WII0013P
<i>Boerhavia diffusa</i> L.	Nyctaginaceae	H	Pusalkar and Singh (2012)	WII00507504543
<i>Fraxinus xanthoxyloides</i> Wall.	Oleaceae	T	Hajra and Balodi (1995)	WII0125P
* <i>Chamerion angustifolium</i> (L.) Holub	Onagraceae	H	Pusalkar and Singh (2012)	WII0073P
<i>Chamerion speciosum</i> (Decne.) Holub	Onagraceae	H	Pusalkar and Singh (2012)	WII0074P
<i>Epilobium cylindricum</i> D.Don	Onagraceae	H	Pusalkar and Singh (2012)	WII20633
* <i>Epilobium laxum</i> Royle	Onagraceae	H	Pusalkar and Singh (2012)	WII0075P
* <i>Epilobium royleanum</i> Hausskn.	Onagraceae	H	Pusalkar and Singh (2012)	WII20666
<i>Epipactis helleborine</i> (L.) Crantz	Orchidaceae	O	Murti (2001)	WII00000003200
* <i>Epipactis royleana</i> Lindl.	Orchidaceae	O	Pusalkar and Singh (2012)	WII00000003204
* <i>Goodyera repens</i> (L.) R.Br.	Orchidaceae	O	Murti (2001)	WII0005P
<i>Gymnadenia orchidis</i> Lindl.	Orchidaceae	O	Pusalkar and Singh (2012)	WII0006P
<i>Herminium monorchis</i> R.Br.	Orchidaceae	O	Murti (2001)	WII20850
<i>Liparis rostrata</i> Rchb.f.	Orchidaceae	O	Pusalkar and Singh (2012)	WII0008P
<i>Malaxis muscifera</i> (Lindl.) Kuntze	Orchidaceae	O	Murti (2001)	WII0009P
* <i>Neottianthe cucullata</i> Schltr.	Orchidaceae	O	www.efloras.org	WII20891
* <i>Peristylus duthiei</i> (Hook.f.) Deva & H.B.Naithani	Orchidaceae	O	Naithani (1984)	WII0007P
* <i>Platanthera latilabris</i> Lindl.	Orchidaceae	O	Naithani (1984)	WII0010P
* <i>Euphrasia himalayica</i> Wettst.	Orobanchaceae	H	Pusalkar and Singh (2012)	WII0127P
* <i>Leptorhabdos parviflora</i> Benth.	Orobanchaceae	H	Pusalkar and Singh (2012)	WII0128P
<i>Orobanche alba</i> Stephan ex Willd.	Orobanchaceae	H	Pusalkar and Singh (2012)	WII0138P
* <i>Pedicularis bicornuta</i> Klotzsch	Orobanchaceae	H	Pusalkar and Singh (2012)	WII20606
<i>Pedicularis longiflora</i> var. <i>tubiformis</i> (Klotzsch) P.C.Tsoong	Orobanchaceae	H	Pusalkar and Singh (2012)	WII0129P
* <i>Pedicularis oederi</i> Vahl	Orobanchaceae	H	Pusalkar and Singh (2012)	WII00000002310
<i>Pedicularis pectinata</i> Wall.	Orobanchaceae	H	Pusalkar and Singh (2012)	WII20638
<i>Pedicularis porrecta</i> Wall.	Orobanchaceae	H	Pusalkar and Singh (2012)	WII0130P
<i>Meconopsis aculeata</i> Royle	Papaveraceae	H	Pusalkar and Singh (2012)	WII00216700103
* <i>Corydalis adiantifolia</i> Hook.f. & Thomson	Papaveraceae	H	www.efloras.org	WII0201P
<i>Corydalis cornuta</i> Royle	Papaveraceae	H	Pusalkar and Singh (2012)	WII20653
<i>Corydalis govaniana</i> Wall.	Papaveraceae	H	Pusalkar and Singh (2012)	WII20897
<i>Corydalis meifolia</i> Wall.	Papaveraceae	H	Chandola (2009)	WII0022P
* <i>Corydalis nana</i> Royle	Papaveraceae	H	Pusalkar and Singh (2012)	WII20610
<i>Corydalis casimiriana</i> Duthie & Prain	Papaveraceae	H	Pusalkar and Singh (2012)	WII0023P
<i>Corydalis</i> sp.	Papaveraceae	H	Pusalkar and Singh (2012)	WII20631
<i>Phytolacca acinosa</i> Roxb.	Phytolaccaceae	H	Pusalkar and Singh (2012)	WII00857202776
* <i>Lagotis kunawurensis</i> Rupr.	Plantaginaceae	H	Pusalkar and Singh (2012)	WII20694
* <i>Picrorhiza scrophulariiflora</i> Pennell	Plantaginaceae	H	Pusalkar and Singh (2012)	WII20885
* <i>Plantago depressa</i> Willd.	Plantaginaceae	H	Pusalkar and Singh (2012)	WII0126P
<i>Plantago himalaica</i> Pilg.	Plantaginaceae	H	Pusalkar and Singh (2012)	WII20862
* <i>Veronica biloba</i> L.	Plantaginaceae	H	Pusalkar and Singh (2012)	WII20881
* <i>Veronica capitata</i> Royle ex Benth.	Plantaginaceae	H	Pusalkar and Singh (2012)	WII21969
* <i>Veronica ciliata</i> Fisch. subsp. <i>cephaloides</i> (Pennell) D.Y.Hong	Plantaginaceae	H	Pusalkar and Singh (2012)	WII20665
* <i>Veronica lanosa</i> Royle ex Benth.	Plantaginaceae	H	Pusalkar and Singh (2012)	WII0132P

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Table 2. Continued.

Plant group	Family	Growth form	Source	Voucher number
* <i>Agrostis gigantea</i> Roth	Poaceae	G	Murti (2001)	WII20648
* <i>Agrostis munroana</i> Aitch. & Hemsl.	Poaceae	G	Murti (2001)	WII21985
<i>Agrostis pilosula</i> Trin.	Poaceae	G	Murti (2001)	WII21991
<i>Agrostis</i> sp.	Poaceae	G	Murti (2001)	WII21987
<i>Andropogon munroi</i> C.B.Clarke	Poaceae	G	Hajra and Balodi (1995)	WII0018P
* <i>Bromus inermis</i> Leyss.	Poaceae	G	Murti (2001)	WII20858
<i>Bromus pectinatus</i> Thunb.	Poaceae	G	Murti (2001)	WII00253603649
* <i>Calamagrostis holciformis</i> Jaub. & Spach	Poaceae	G	Murti (2001)	WII21998
* <i>Calamagrostis pseudophragmites</i> (Haller f.) Koeler	Poaceae	G	Murti (2001)	WII21997
<i>Calamagrostis</i> sp.	Poaceae	G	Murti (2001)	WII20859
<i>Chrysopogon gryllus</i> (L.) Trin. subsp. <i>echinulatus</i> (Nees) Cope	Poaceae	G	Murti (2001)	WII20615
<i>Dactylis glomerata</i> L.	Poaceae	G	Murti (2001)	WII21992
<i>Danthonia cachemyriana</i> Jaub. & Spach	Poaceae	G	Murti (2001)	WII00335103746
<i>Elymus nutans</i> Griseb.	Poaceae	G	Murti (2001)	WII20831
<i>Elymus longiaristatus</i> subsp. <i>canaliculatus</i> (Nevski) Tzvelev	Poaceae	G	Murti (2001)	WII21993
* <i>Festuca kashmiriana</i> Stapf	Poaceae	G	Murti (2001)	WII20622
* <i>Festuca tibetica</i> (Stapf) E.B.Alexeev	Poaceae	G	Murti (2001)	WII20819
<i>Festuca valesiaca</i> Schleich. ex Gaudin	Poaceae	G	Murti (2001)	WII20838
* <i>Hierochloe flexuosa</i> Hook.f.	Poaceae	G	www.efloras.org	WII21967
* <i>Hierochloe laxa</i> R.Br.	Poaceae	G	Murti (2001)	WII0019P
* <i>Hordeum vulgare</i> L.	Poaceae	G	Chandola (2009)	WII0020P
* <i>Koeleria macrantha</i> (Ledeb.) Schult.	Poaceae	G	Murti (2001)	WII20613
<i>Melica persica</i> Kunth	Poaceae	G	Murti (2001)	WII20623
* <i>Melica scaberrima</i> Hook.f.	Poaceae	G	Chandola (2009)	WII20803
* <i>Oryzopsis gracilis</i> (Mez) Pilg.	Poaceae	G	Pusalkar and Singh (2012)	WII21988
* <i>Oryzopsis munroi</i> Stapf ex Hook.f.	Poaceae	G	Murti (2001)	WII20813
* <i>Pennisetum flaccidum</i> Griseb.	Poaceae	G	Murti (2001)	WII20673
* <i>Phleum alpinum</i> L.	Poaceae	G	Murti (2001)	WII20609, WII20618
<i>Poa alpina</i> L.	Poaceae	G	Murti (2001)	WII22002
* <i>Poa pratensis</i> L.	Poaceae	G	Murti (2001)	WII21965
<i>Poa</i> sp.	Poaceae	G	Murti (2001)	WII22000
<i>Poa</i> sp.	Poaceae	G	Murti (2001)	WII22005
<i>Poa</i> sp.	Poaceae	G	Murti (2001)	WII22008
<i>Poa</i> sp.	Poaceae	G	Murti (2001)	WII22012
* <i>Polypogon fugax</i> Nees ex Steud.	Poaceae	G	Murti (2001)	WII00853504036
* <i>Puccinellia</i> sp.	Poaceae	G	Murti (2001)	WII22001
* <i>Setaria pumila</i> (Poir.) Roem. & Schult.	Poaceae	G	Murti (2001)	WII21986
<i>Stipa</i> sp.	Poaceae	G	Murti (2001)	WII0021P
<i>Trisetum</i> sp.	Poaceae	G	Murti (2001)	WII22012
<i>Trisetum</i> sp.	Poaceae	G	Murti (2001)	WII22015
* <i>Trisetum spicatum</i> (L.) K.Richt.	Poaceae	G	Murti (2001)	WII22010
* <i>Polemonium caeruleum</i> L.	Polemoniaceae	H	Pusalkar and Singh (2012)	WII21968
<i>Bistorta affinis</i> Greene	Polygonaceae	H	Pusalkar and Singh (2012)	WII20834
<i>Bistorta vacciniifolia</i> Greene	Polygonaceae	H	Pusalkar and Singh (2012)	WII0085P
<i>Bistorta vivipara</i> (L.) Gray	Polygonaceae	H	Pusalkar and Singh (2012)	WII20636
* <i>Bistorta tenuifolia</i> (H.W.Kung) Miyam. & H.Ohba var. <i>gidarensis</i> I.D.Rai, Singh & Rawat	Polygonaceae	H	Rai et al. (2013)	WII20678
<i>Fagopyrum dibotrys</i> (D.Don) Hara	Polygonaceae	H	Pusalkar and Singh (2012)	WII0086P
<i>Fagopyrum esculentum</i> Moench	Polygonaceae	H	Pusalkar and Singh (2012)	WII0087P
* <i>Knorringia sibirica</i> (Laxm.) Tzvelev	Polygonaceae	H	Pusalkar and Singh (2012)	WII20856
* <i>Koenigia nepalensis</i> D.Don	Polygonaceae	H	Pusalkar and Singh (2012)	WII0088P
<i>Koenigia delicatula</i> (Meisn.) Hara	Polygonaceae	H	Pusalkar and Singh (2012)	WII0089P
<i>Oxyria digyna</i> Hill	Polygonaceae	H	Pusalkar and Singh (2012)	WII00320302778
<i>Persicaria nepalensis</i> (Meisn.) Miyabe	Polygonaceae	H	Pusalkar and Singh (2012)	WII0090P
<i>Pleuropterypyrum rumicifolium</i> (Royle ex Bab.) Munshi & Javeid	Polygonaceae	H	Pusalkar and Singh (2012)	WII0083P
* <i>Polygonum plebeium</i> R.Br.	Polygonaceae	H	Pusalkar and Singh (2012)	WII20867
* <i>Polygonum tortuosum</i> D.Don	Polygonaceae	H	Pusalkar and Singh (2012)	WII0084P
<i>Rheum australe</i> D.Don	Polygonaceae	H	Pusalkar and Singh (2012)	WII0196P
<i>Rheum moorcroftianum</i> Royle	Polygonaceae	H	Pusalkar and Singh (2012)	WII0091P
* <i>Rheum tibeticum</i> Maxim. ex Hook.f.	Polygonaceae	H	Chandola (2009)	WII20696
<i>Rheum webbianum</i> Royle	Polygonaceae	H	Pusalkar and Singh (2012)	WII0092P

Continued

Table 2. Continued.

Plant group	Family	Growth form	Source	Voucher number
<i>Rubrivena polystachya</i> (Wall. ex Meisn.) M.Kral	Polygonaceae	H	Pusalkar and Singh (2012)	WII00329702809
<i>Rumex acetosa</i> L.	Polygonaceae	H	Pusalkar and Singh (2012)	WII20645
<i>Rumex nepalensis</i> Spreng.	Polygonaceae	H	Pusalkar and Singh (2012)	WII00396302825
<i>Androsace delavayi</i> Franch.	Primulaceae	H	Pusalkar and Singh (2012)	WII0108P
<i>Androsace globifera</i> Duby	Primulaceae	H	Pusalkar and Singh (2012)	WII20677
<i>Androsace rotundifolia</i> Hardw.	Primulaceae	H	Pusalkar and Singh (2012)	WII0109P
<i>Androsace sarmentosa</i> Wall.	Primulaceae	H	Pusalkar and Singh (2012)	WII20625
<i>Primula denticulata</i> Sm.	Primulaceae	H	Pusalkar and Singh (2012)	WII20808
<i>Primula involucrata</i> Wall. ex Duby	Primulaceae	H	Pusalkar and Singh (2012)	WII20626
<i>Aconitum lethale</i> Griff.	Ranunculaceae	H	Pusalkar and Singh (2012)	WII0024P
<i>Aconitum violaceum</i> Jacquem. ex Stapf	Ranunculaceae	H	Pusalkar and Singh (2012)	WII0025P
<i>Actaea acuminata</i> Royle	Ranunculaceae	H	Pusalkar and Singh (2012)	WII0026P
<i>Anemone rivularis</i> Buch.-Ham. ex DC.	Ranunculaceae	H	Pusalkar and Singh (2012)	WII20650
<i>Anemone rupicola</i> Cambess.	Ranunculaceae	H	Pusalkar and Singh (2012)	WII20607
<i>Anemone tetrasepala</i> Royle	Ranunculaceae	H	Pusalkar and Singh (2012)	WII00000100006
* <i>Aquilegia fragrans</i> Benth.	Ranunculaceae	H	Pusalkar and Singh (2012)	WII20695
<i>Clematis orientalis</i> L.	Ranunculaceae	C	Pusalkar and Singh (2012)	WII00287600024
<i>Delphinium brunonianum</i> Royle	Ranunculaceae	H	Pusalkar and Singh (2012)	WII20669
<i>Delphinium cashmerianum</i> Royle	Ranunculaceae	H	Pusalkar and Singh (2012)	WII20658
* <i>Delphinium densiflorum</i> Duthie ex Huth	Ranunculaceae	H	Pusalkar and Singh (2012)	WII0027P
* <i>Delphinium caeruleum</i> Jacquem. ex Cambess.	Ranunculaceae	H	Pusalkar and Singh (2012)	WII20678
* <i>Paraquilegia anemonoides</i> Ulbr.	Ranunculaceae	H	Pusalkar and Singh (2012)	WII20830
<i>Ranunculus hirtellus</i> Royle	Ranunculaceae	H	Pusalkar and Singh (2012)	WII20655
<i>Ranunculus pulchellus</i> C.A.Mey.	Ranunculaceae	H	Pusalkar and Singh (2012)	WII0028P
* <i>Ranunculus radicans</i> C.A.Mey.	Ranunculaceae	H	Pusalkar and Singh (2012)	WII20604
<i>Thalictrum alpinum</i> L.	Ranunculaceae	H	Pusalkar and Singh (2012)	WII20802
<i>Thalictrum cultratum</i> Wall.	Ranunculaceae	H	Pusalkar and Singh (2012)	WII20889
<i>Thalictrum foliolosum</i> DC.	Ranunculaceae	H	Pusalkar and Singh (2012)	WII00000700051
* <i>Thalictrum platycarpum</i> Greene	Ranunculaceae	H	Pusalkar and Singh (2012)	WII0029P
<i>Thalictrum</i> sp.	Ranunculaceae	H	Pusalkar and Singh (2012)	WII20687
<i>Berchemia edgeworthii</i> Lawson	Rhamnaceae	S	Pusalkar and Singh (2012)	WII0066P
<i>Rhamnus prostrata</i> Jacquem.	Rhamnaceae	S	Pusalkar and Singh (2012)	WII00261900551
* <i>Aruncus dioicus</i> (Walter) Fernald	Rosaceae	H	Pusalkar and Singh (2012)	WII0047P
* <i>Cotoneaster bacillaris</i> Wall. ex Lindl.	Rosaceae	S	Naithani (1984)	WII00000001017
* <i>Cotoneaster duthieanus</i> (C.K.Schneid.) G.Klotz	Rosaceae	S	Pusalkar and Singh (2012)	WII0048P
<i>Cotoneaster garhwalensis</i> G.Klotz	Rosaceae	S	Hajra and Balodi (1995)	WII0049P
<i>Cotoneaster integrifolius</i> (Roxb.) G.Klotz	Rosaceae	S	Hajra and Balodi (1995)	WII20671
* <i>Cotoneaster marginatus</i> (Loudon) Schltdl.	Rosaceae	S	Pusalkar and Singh (2012)	WII0050P
<i>Cotoneaster microphyllus</i> Wall. ex Lindl.	Rosaceae	S	Pusalkar and Singh (2012)	WII0051P
* <i>Cotoneaster roseus</i> Edgew.	Rosaceae	S	Pusalkar and Singh (2012)	WII0052P
<i>Fragaria nubicola</i> Lindl. ex Lacaita	Rosaceae	H	Pusalkar and Singh (2012)	WII0053P
* <i>Malus domestica</i> Borkh.	Rosaceae	T	Pusalkar and Singh (2012)	WII0054P
* <i>Potentilla anserina</i> L.	Rosaceae	H	www.efloras.org	WII0055P
<i>Potentilla argyrophylla</i> Wall. ex Lehm.	Rosaceae	H	Pusalkar and Singh (2012)	WII20842
<i>Potentilla atrosanguinea</i> Lodd., G.Lodd. & W.Lodd.	Rosaceae	H	Pusalkar and Singh (2012)	WII00648301036
<i>Potentilla biflora</i> D.F.K.Schltdl.	Rosaceae	H	Pusalkar and Singh (2012)	WII20896
<i>Potentilla bifurca</i> L.	Rosaceae	H	Pusalkar and Singh (2012)	WII20861
* <i>Potentilla cuneifolia</i> Bertol.	Rosaceae	H	Pusalkar and Singh (2012)	WII0056P
* <i>Potentilla curviseta</i> Hook.f.	Rosaceae	H	www.efloras.org	WII0057P
<i>Potentilla gelida</i> C.A.Mey.	Rosaceae	H	Pusalkar and Singh (2012)	WII0208P
<i>Potentilla microphylla</i> D.Don	Rosaceae	H	Pusalkar and Singh (2012)	WII20674
<i>Potentilla multifida</i> L.	Rosaceae	H	Pusalkar and Singh (2012)	WII20879
* <i>Potentilla pamirica</i> Th.Wolf	Rosaceae	H	www.efloras.org	WII20661
<i>Potentilla rigida</i> Wall. ex Lehm.	Rosaceae	S	Pusalkar and Singh (2012)	WII21967
* <i>Prunus armeniaca</i> L.	Rosaceae	T	Pusalkar and Singh (2012)	WII00000001053
<i>Prunus cornuta</i> (Wall. ex Royle) Steud.	Rosaceae	T	Pusalkar and Singh (2012)	WII00594401062
<i>Prunus persica</i> (L.) Batsch	Rosaceae	T	Pusalkar and Singh (2012)	WII0205P
<i>Prunus jacquemontii</i> Hook.f.	Rosaceae	T	Hajra and Balodi (1995)	WII0058P
<i>Rosa beggeriana</i> Schrenk	Rosaceae	S	Pusalkar and Singh (2012)	WII0060P
<i>Rosa macrophylla</i> Lindl. var. <i>minor</i> Lindl.	Rosaceae	S	Pusalkar and Singh (2012)	WII0061P
<i>Rosa sericea</i> Lindl.	Rosaceae	S	Pusalkar and Singh (2012)	WII0059421096

Continued

Table 2. Continued.

Plant group	Family	Growth form	Source	Voucher number
<i>Rosa webbiana</i> Wall. ex Royle	Rosaceae	S	Pusalkar and Singh (2012)	WII0029081097
<i>Sibbaldia parviflora</i> Willd.	Rosaceae	H	Pusalkar and Singh (2012)	WII20833
<i>Sorbaria tomentosa</i> (Lindl.) Rehder	Rosaceae	S	Pusalkar and Singh (2012)	WII0000001135
* <i>Sorbus aucuparia</i> L.	Rosaceae	S	Pusalkar and Singh (2012)	WII0062P
<i>Sorbus microphylla</i> Wenz.	Rosaceae	S	Pusalkar and Singh (2012)	WII0062P
* <i>Spiraea arcuata</i> Hook.f.	Rosaceae	S	Pusalkar and Singh (2012)	WII0063P
<i>Spiraea canescens</i> D.Don.	Rosaceae	S	Pusalkar and Singh (2012)	WII0064P
<i>Galium aparine</i> L.	Rubiaceae	H	Pusalkar and Singh (2012)	WII00602504598
* <i>Galium asperuloides</i> Edgew.	Rubiaceae	H	Pusalkar and Singh (2012)	WII0112P
* <i>Galium rotundifolium</i> L.	Rubiaceae	H	Pusalkar and Singh (2012)	WII0113P
<i>Leptodermis lanceolata</i> Wall.	Rubiaceae	S	Pusalkar and Singh (2012)	WII00466101491
<i>Rubia cordifolia</i> L.	Rubiaceae	C	Pusalkar and Singh (2012)	WII00289401532
<i>Populus ciliata</i> Wall. ex Royle	Salicaceae	T	Pusalkar and Singh (2012)	WII00856103161
* <i>Salix daphnoides</i> Vill.	Salicaceae	S	Pusalkar and Singh (2012)	WII0209P
<i>Salix denticulata</i> Andersson	Salicaceae	S	Pusalkar and Singh (2012)	WII0068P
<i>Salix karelinii</i> Turcz. ex Stschegl.	Salicaceae	S	Pusalkar and Singh (2012)	WII0210P
<i>Salix lindleyana</i> Wall. ex Andersson	Salicaceae	S	Pusalkar and Singh (2012)	WII00593803168
<i>Salix</i> sp.	Salicaceae	S	Pusalkar and Singh (2012)	WII20672
<i>Thesium himalense</i> Royle	Santalaceae	H	Pusalkar and Singh (2012)	WII0081P
<i>Acer acuminatum</i> Wall. ex D.Don	Sapindaceae	T	Pusalkar and Singh (2012)	WII0212P
<i>Bergenia ciliata</i> (Haw.) Sternb.	Saxifragaceae	H	Pusalkar and Singh (2012)	WII0213P
<i>Bergenia stracheyi</i> (Hook.f. & Thomson) Engl.	Saxifragaceae	H	Pusalkar and Singh (2012)	WII20841
<i>Saxifraga brunonis</i> Ser.	Saxifragaceae	H	Pusalkar and Singh (2012)	WII0033P
* <i>Saxifraga crenua</i> L.	Saxifragaceae	H	Pusalkar and Singh (2012)	WII0034P
<i>Saxifraga flagellaris</i> Willd.	Saxifragaceae	H	Pusalkar and Singh (2012)	WII20679
<i>Saxifraga sibirica</i> L.	Saxifragaceae	H	Pusalkar and Singh (2012)	WII0035P
<i>Saxifraga wallichiana</i> Sternb.	Saxifragaceae	H	Pusalkar and Singh (2012)	WII0032P
* <i>Scrophularia dentata</i> Royle ex Benth.	Scrophulariaceae	H	Pusalkar and Singh (2012)	WII20853
<i>Scrophularia edgeworthii</i> Benth.	Scrophulariaceae	H	Pusalkar and Singh (2012)	WII0131P
<i>Verbascum thapsus</i> L.	Scrophulariaceae	H	Pusalkar and Singh (2012)	WII00432102234
<i>Hyoscyamus niger</i> L.	Solanaceae	H	Pusalkar and Singh (2012)	WII0123P
<i>Physochlaina praealta</i> Miers	Solanaceae	H	Pusalkar and Singh (2012)	WII20825
* <i>Solanum tuberosum</i> L.	Solanaceae	H	Pusalkar and Singh (2012)	WII0124P
<i>Myricaria elegans</i> Royle	Tamaricaceae	S	Pusalkar and Singh (2012)	WII0082P
<i>Myricaria rosea</i> W.W.Sm.	Tamaricaceae	S	Pusalkar and Singh (2012)	WII20888
<i>Urtica dioica</i> L.	Urticaceae	H	Pusalkar and Singh (2012)	WII00632003116
* <i>Urtica hyperborea</i> Jacquem. ex Wedd.	Urticaceae	H	Pusalkar and Singh (2012)	WII00286703117
<i>Viola betonicifolia</i> Sm.	Violaceae	H	Pusalkar and Singh (2012)	WII00604804662
<i>Viola biflora</i> L.	Violaceae	H	Pusalkar and Singh (2012)	WII0069P
* <i>Viola kunawurensis</i> Royle	Violaceae	H	Chandola (2009)	WII20676
Gymnosperms				
<i>Cupressus torulosa</i> D.Don	Cupressaceae	T	Pusalkar and Singh (2012)	WII00000003185
<i>Juniperus communis</i> L.	Cupressaceae	S	Pusalkar and Singh (2012)	WII00000003174
<i>Juniperus indica</i> Bertol.	Cupressaceae	S	Pusalkar and Singh (2012)	WII0187P
<i>Juniperus semiglobosa</i> Regel	Cupressaceae	T	Pusalkar and Singh (2012)	WII20883
<i>Ephedra gerardiana</i> Wall. ex Stapf	Ephedraceae	S	Pusalkar and Singh (2012)	WII0183P
<i>Abies pindrow</i> Spach	Pinaceae	T	Pusalkar and Singh (2012)	WII20875
<i>Abies spectabilis</i> Spach	Pinaceae	T	Pusalkar and Singh (2012)	WII0184P
<i>Cedrus deodara</i> (Roxb. ex D.Don) G.Don	Pinaceae	T	Pusalkar and Singh (2012)	WII0185P
<i>Picea smithiana</i> Boiss.	Pinaceae	T	Pusalkar and Singh (2012)	WII20869
<i>Pinus wallichiana</i> A.B.Jacks.	Pinaceae	T	Pusalkar and Singh (2012)	WII0186P
Pteridophytes				
<i>Adiantum venustum</i> D.Don	Adiantaceae	F	Khullar (2000)	WII00333704147
<i>Asplenium septentrionale</i> (L.) Hoffm.	Aspleniaceae	F	Khullar (2000)	WII0190P
* <i>Athyrium foliolosum</i> (Wall.) Moore	Athyriaceae	F	Khullar (2000)	WII0192P
* <i>Deparia allantodioides</i> (Bedd.) M.Kato	Athyriaceae	F	Khullar (2000)	WII0193P
* <i>Dryopteris barbigera</i> (Moore) Kuntze	Dryopteridaceae	F	Khullar (2000)	WII00340404149
<i>Equisetum diffusum</i> D.Don	Equisetaceae	F	Pusalkar and Singh (2012)	WII0188P
<i>Lepisorus</i> sp.	Polypodiaceae	F	Khullar (2000)	WII0194P
<i>Onychium</i> sp.	Pteridaceae	F	Khullar (2000)	WII0189P
* <i>Thelypteris levingei</i> (C.B.Clarke) Ching	Thelypteridaceae	F	Khullar (2000)	WII0191P

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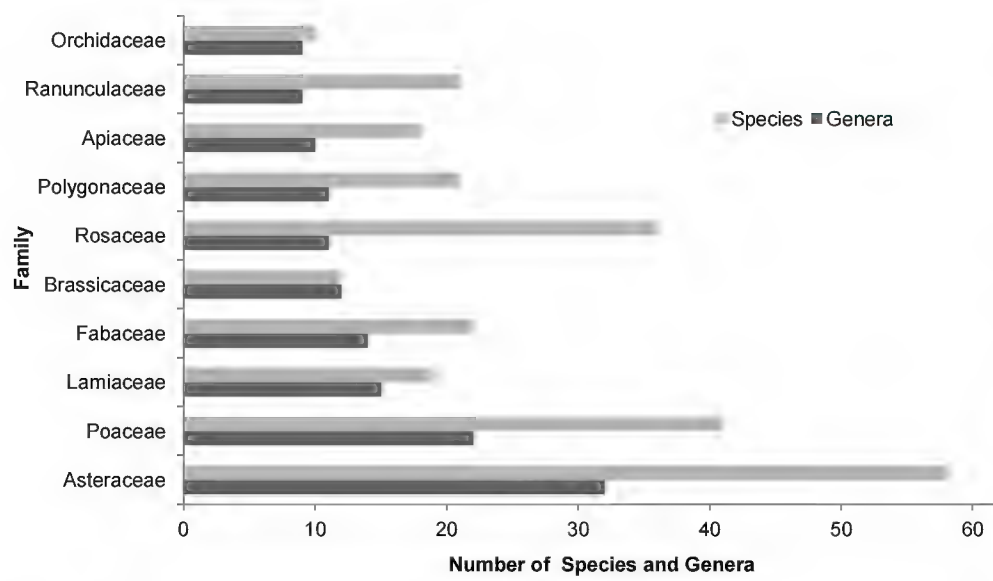


Figure 2. Dominant families with number of genera and species in Niti valley, Nanda Devi Biosphere Reserve, India.

species richness in the valley were Asteraceae (32 genera with 58 species) followed by Poaceae (22 genera with 41 species) and Lamiaceae (15 genera with 19 species; Figure 2). Analysis of data indicates that 52% of total species found in the present flora belongs to these ten dominating families (Figure 2). The presence of families such as Asteraceae, Poaceae, Lamiaceae, Fabaceae, Brassicaceae, Rosaceae, Polygonaceae, Apiaceae, Ranunculaceae and Orchidaceae could be attributed to the mesic conditions in the valley. Among gymnosperms, three major families (Pinaceae, Ephedraceae and Cupressaceae) were recorded, of which Pinaceae had five species, Cupressaceae had four species and Ephedraceae had only one species. A total of nine species (eight families with nine genera) of pteridophytes were recorded from the valley, with the family Athyriaceae having two species. Altogether, 24 families (Adiantaceae, Aspleniaceae, Betulaceae, Bignoniaceae, Cannabaceae, Celastraceae, Dioscoreaceae, Dryopteridaceae, Ephedraceae, Equisetaceae, Hydrangeaceae, Hypericaceae, Iridaceae, Juglandaceae, Nartheciaceae, Nyctaginaceae, Oleaceae, Phytolaccaceae, Polemoniaceae, Polypodiaceae, Pteridaceae, Santalaceae, Sapindaceae and Thelypteridaceae) were represented by single species in Niti valley. Among the different growth forms, herbs contributed 70.7% followed by shrubs (11.3%), grasses (7.2%), sedges (4.3%) trees (2.6%), climbers and ferns (1.8% each). The currently accepted name of the plant, author citation, family, habit and voucher specimen's number for each species is given in Table 2.

Potentilla L. was the dominant genus with 12 species, including one shrub species (*Potentilla rigida* Wall. ex Lehm.), followed by the monocotyledons (*Carex* L. and *Kobresia* Willd.) with nine species each, and dicotyledons such as *Artemisia* L., *Corydalis* DC. and *Silene* L. (seven species each) and *Astragalus* L. and *Poa* L. (six species each). The other common herbaceous vegetation were *Anaphalis* DC., *Oxytropis* DC., *Danthonia* DC., *Pedicularis* L., *Androsace* L., *Saxifraga* L. and *Rhodiola* L. Among

the shrubs, *Cotoneaster* with seven species followed by *Lonicera* L. (five) dominated the valley, while *Juniperus indica* Bertol., *Juniperus communis* L., *Caragana versicolor* Benth., *Krascheninnikovia ceratoides* (L.) Gueldenst., *Potentilla rigida* Wall. ex Lehm., *Devendraea* sp., *Rosa* sp., *Ephedra gerardiana* Wall. ex Stapf, *Rhododendron anthopogon* D.Don, *R. lepidotum* Wall. ex G.Don, *Hippophae* sp. and *Salix* sp., were common. The major trees found in the valley were *Pinus wallichiana* A.B.Jacks., *Cedrus deodara* (Roxb. ex D.Don) G.Don, *Picea smithiana* Boiss., *Betula utilis* D.Don, *Fraxinus xanthoxyloides* Wall. and *Juniperus semiglobosa* Regel. *Pinus wallichiana* A.B.Jacks., *Pinus-Cedrus*, and *Pinus-Cedrus-Picea* were the major forest communities in the lower reaches of the valley. Additionally, *Betula utilis* D.Don was the major community alongside steep ridges protruding towards hill tops. *Rumex nepalensis* Spreng., locally known as *khoksya*, was found growing excessively in open riverine and alpine tracts of Amrit Ganga (Dhaman payar), animal resting places, near human habitations and agricultural fields throughout the valley. An overview of the study area with some specific habitats, rare and important medicinal plants in the region are shown in Figures 3–6.

Threatened taxa

Saussurea costus (Falc.) Lipsch. (locally known as *kuth*; cultivated) and *Juniperus semiglobosa* Regel were recorded from the region, which are listed as Critically Endangered and Least Concern, respectively (IUCN 2015). *Aconitum lethale* Griff. and *Allium stracheyi* Baker (wild as well as cultivated) were reported as Indeterminate and Vulnerable, respectively, as per Walter and Gillett (1998). *Allium carolinianum* DC. (Vulnerable), *Thermopsis barbata* Benth. (Vulnerable), *Thylacospermum caespitosum* (Cambess.) Schischk. (Endangered) and *Viola kunawurensis* Royle (Critically Endangered) are threatened species of cold-arid regions as per Srivastava (2010); *Allium stracheyi* Baker (Vulnerable) as per Nayar and Sastry (1987–90) and *Dioscorea deltoidea* Wall. in the Appendix II of CITES (2003). Additionally, the valley also harbours 23 threatened plants, which falls under various threat categories as per Conservation Assessment and Management Prioritization of selected medicinal plants in Western Himalaya (Ved et al. 2003; Table 3). Of these, 35%, 35%, 22% and 8% plants were Endangered, Vulnerable, Near Threatened and Critically Endangered, respectively. Moreover, despite the presence of suitable habitats in Amrit Ganga watershed, the authors did not find any individuals of *Dactylorhiza hatagirea* (D.Don) Soo from the valley. However, local inhabitants of the valley mentioned its presence in the valley, though the identity of this plant is mostly confused among locals with *Gymnadenia orchidis* Lindl.

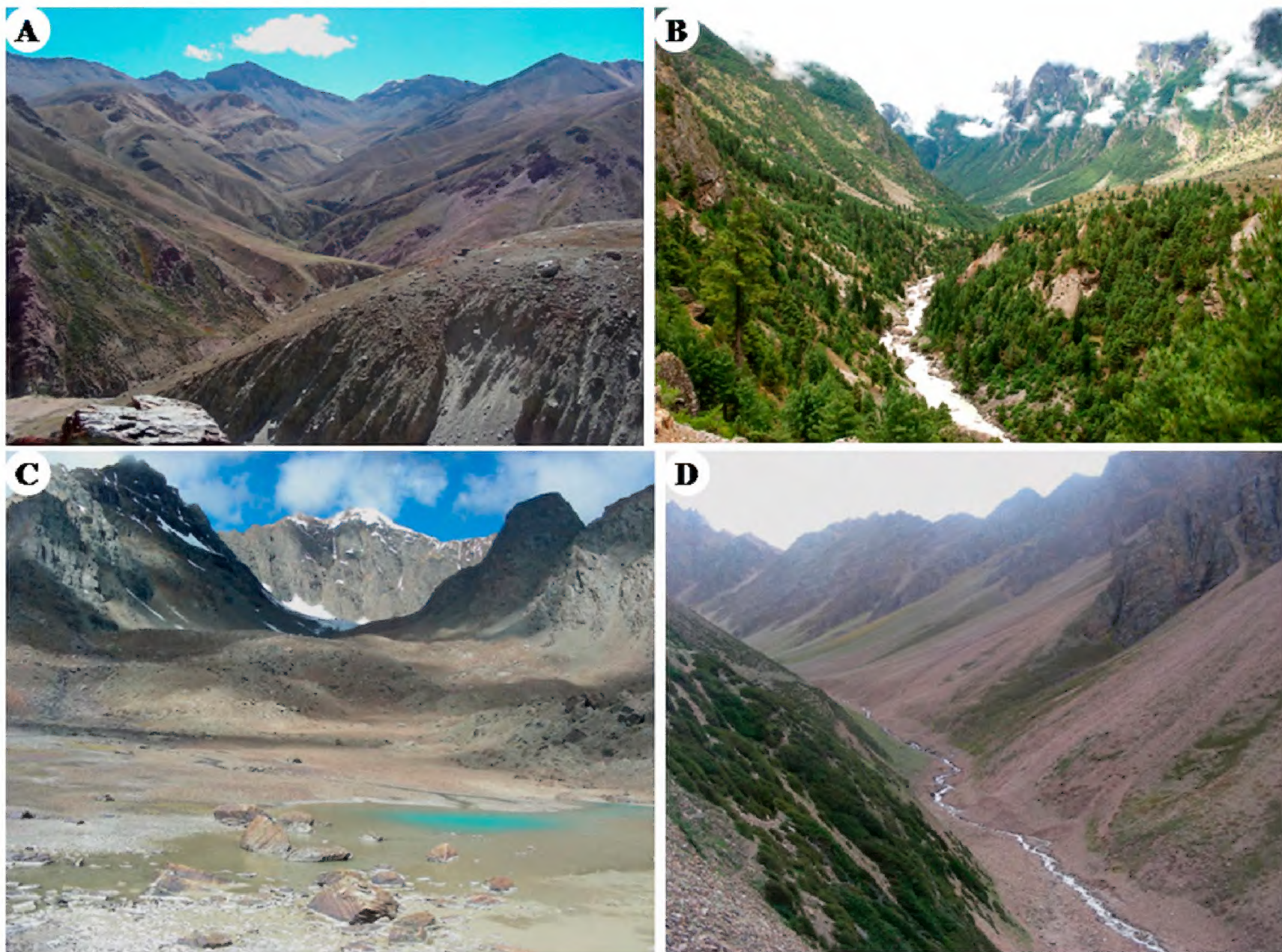


Figure 3. An overview of the valley at different locations. (A) Dry alpine pastures towards Geldung (4,500–5,500 m); (B) *Pinus-Cedrus* forests (3,200–3,600 m) along the river *Dhaul Ganga*; (C) Glacial lake at Geldung (5,030 m); (D) Scree slopes on left bank and *Caragana* scrub on right bank of Satyagad watershed (>4,000 m). Photos: Amit Kumar.

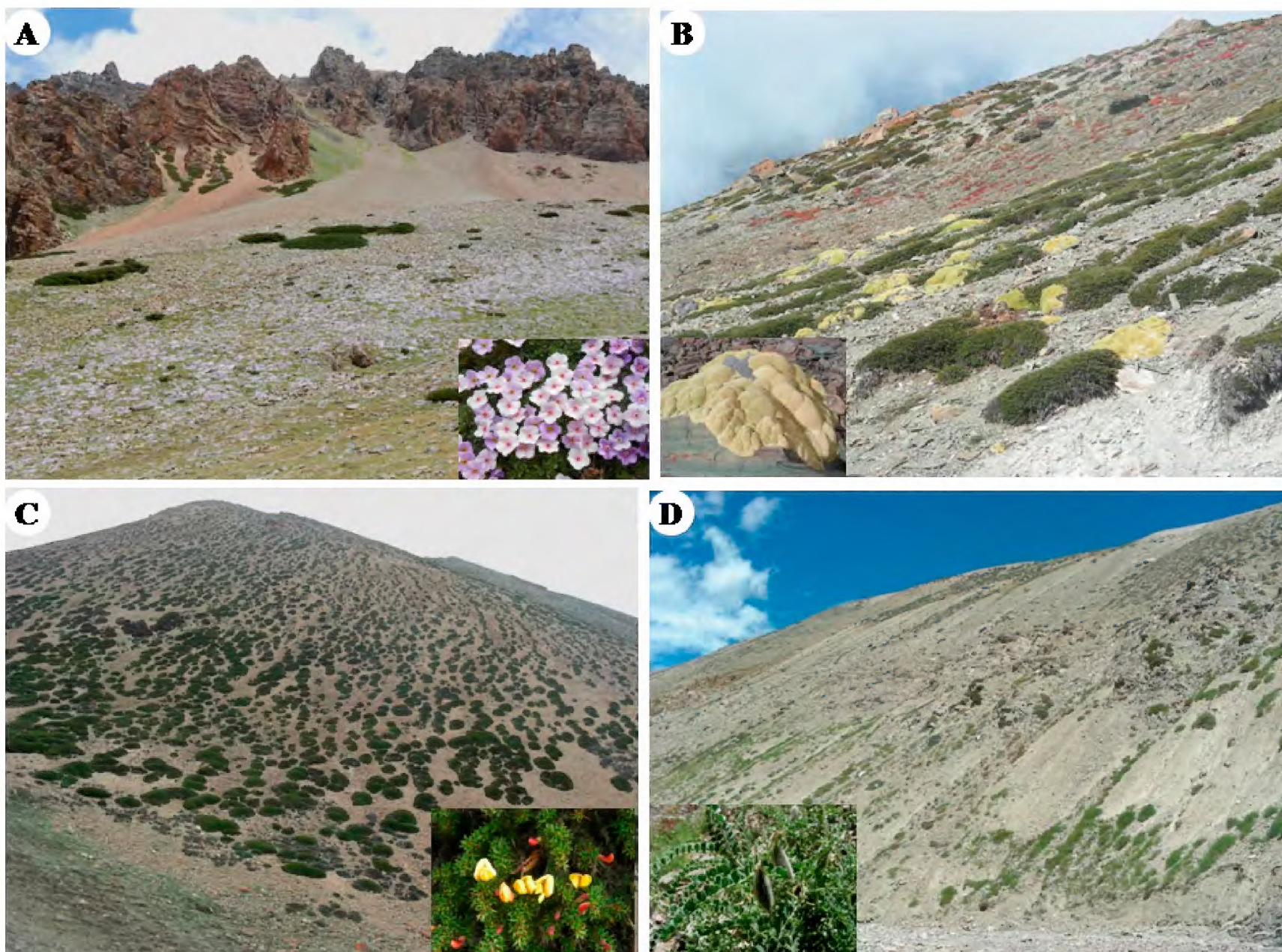


Figure 4. Specific habitats of different species (above 4,500 m). (A) Open dry slope covered by *Androsace globifera*; (B) *Thylacospermum caespitosum* amidst *Caragana versicolor* on gentle slopes; (C) *Caragana* steppe; (D) *Cicer microphyllum* on dry steep slopes along the *Dhaul Ganga* River. Photos: Amit Kumar.



Figure 5. Few rare species of the valley. (A) *Saussurea nana*; (B) *Corydalis nana*; (C) *Leontopodium nanum*; (D) *Neottianthe cucullata*; (E) *Aconitum lethale*; (F) *Dioscorea deltoidea*; (G) *Sinopodophyllum hexandrum*; (H) *Hyoscyamus niger*. Photos: Amit Kumar.

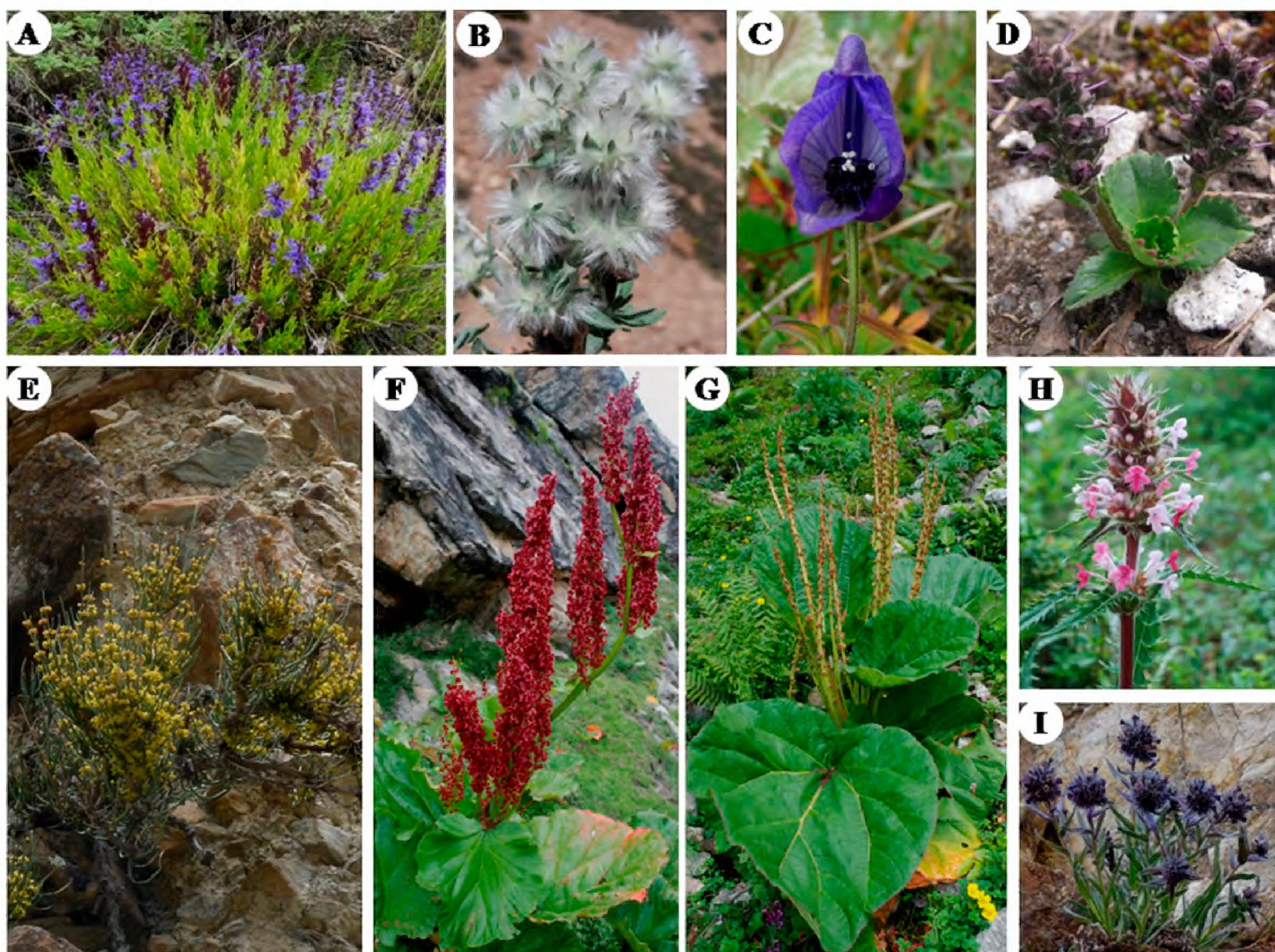


Figure 6. Few important medicinal plants in the valley. (A) *Hyssopus officinalis*; (B) *Krascheninnikovia ceratoides*; (C) *Aconitum violaceum*; (D) *Picrorhiza scrophulariiflora*; (E) *Ephedra gerardiana*; (F) *Rheum australe*; (G) *Rheum moorcroftianum*; (H) *Morina longifolia*; (I) *Arnebia euchroma*. Photos: Amit Kumar.

Table 3. List of taxa in each threat category in Niti valley, Nanda Devi Biosphere Reserve, Western Himalaya, India. Abbreviations used: CR=Critically Endangered, EN=Endangered, VU=Vulnerable, NT=Near Threatened, I=Indeterminate, AG= Amrit Ganga, GG= Ganesh Ganga, SG= Satyagad. Ved et al. (2003).

Species	Vernacular name	Potential localities	Conservation Assessment and Management Prioritization Report
<i>Aconitum lethale</i> Griff.	Meetha	AG	VU
<i>Aconitum violaceum</i> Jacquem. ex Stapf	Atis	SG	VU
<i>Allium stracheyi</i> Baker	Jambu Faran	AG, SG, GG	VU
<i>Angelica glauca</i> Edgew.	Choru	AG	EN
<i>Arnebia benthamii</i> (Wall. ex G.Don) I.M.Johnst.	Balchadi, Laljari	GG	CR
<i>Arnebia euchroma</i> I.M.Johnst.	Balchadi, Laljari	GG	EN
<i>Artemisia maritima</i> L.	Purchu	AG, GG	NT
<i>Bergenia stracheyi</i> (Hook.f. & Thomson) Engl.	Silfore	GG	NT
<i>Betula utilis</i> D.Don	Bhuj	AG, SG, GG	NT
<i>Dioscorea deltoidea</i> Wall.	—	AG	EN
<i>Dolomiaea macrocephala</i> DC.	—	AG	EN
<i>Ephedra gerardiana</i> Wall. ex Stapf	Somlata	AG, GG	EN
<i>Hippophae salicifolia</i> D.Don	Ames	AG	NT
<i>Hyoscyamus niger</i> L.	Phagun	AG	VU
<i>Meconopsis aculeata</i> Royle	—	AG	EN
<i>Polygonatum cirrhifolium</i> Royle	—	AG	VU
<i>Polygonatum verticillatum</i> All.	Salammisri	AG	VU
<i>Rheum moorcroftianum</i> Royle	Dholu	GG	NT
<i>Rheum webbianum</i> Royle	Tatar, Tatri	AG	VU
<i>Rhodiola heterodonta</i> (Hook.f. & Thomson) Boriss.	—	AG, GG	VU
<i>Saussurea costus</i> (Falc.) Lipsch.	Kuth	cultivated	EN
<i>Saussurea obvallata</i> Wall.	Brahma Kamal	SG	EN
<i>Sinopodophyllum hexandrum</i> (Royle) T.S.Ying	Ban kakri	AG	EN

DISCUSSION

The presence of 495 species of vascular plants in an area of ca. 726 km² indicates rich floral diversity and it can be said that this area has high species richness as compared to Nilang valley (1,360 km²), an adjacent Trans-Himalayan valley (441 species) in the state. In the Satyagad (Kalazowar) and Ganesh Ganga watersheds, towards inner side of the valley, species such as *Caragana versicolor* Benth., *Cousinia thomsonii* C.B.Clarke, *Ephedra gerardiana* Wall. ex Stapf, *Festuca tibetica* (Stapf) E.B.Alexeev, *Hippophae tibetana* Schltdl., *Juniperus semiglobosa* Regel, *Kraschenninikovia ceratoides* (L.) Gueldenst., *Melica persica* Kunth and *Rheum tibeticum* Maxim. ex Hook.f. show affinities with the Trans-Himalayan region due to increasing aridity. The mosaics of *Caragana* scrub alone and amidst *Kraschenninikovia ceratoides* (L.) Gueldenst., *Devendraea spinosa* (Decne.) Pusalkar and *Potentilla rigida* Wall. ex Lehm. add a peculiar appearance to the landscape in the Geldung and Kalazowar regions. Moreover, the presence of cushioned dwarf herbs such as *Thylacospermum caespitosum* (Cambess.) Schischk. on east and south-east slopes near Geldung Lake (above 5,000 m) and *Arenaria festucoides* Benth. and *Androsace globifera* Duby in Kalajowar (above 4,000 m) were among the typical Trans-Himalayan floral elements. However, the Amrit Ganga watershed (Dhaman payar) is comparatively rich in flora due to reasonably moist conditions and affinities of floral characteristics with the Greater Himalayan

region, especially in lateral moraines, open riverine tracts and mixed herbaceous formations with species of *Rhododendron campanulatum* D.Don, *R. lepidotum* Wall. ex G.Don, *Cassiope fastigiata* D.Don, *Trachydium roylei* Lindl., *Potentilla* L., *Anaphalis* DC., *Gentiana* L., *Rosa* L., *Sorbus* L., *Primula* L. and *Pedicularis* L. Therefore, based on the existence of phyto-elements from both the Trans and Greater Himalayan regions, it can be concluded that the Niti valley forms a transition zone.

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